

# **New Hampshire Volunteer River Assessment Program 2005 Lake Winnepesaukee Tributaries Water Quality Report**



*Photo: Lake Winnepesaukee*

Prepared by:

State of New Hampshire  
Department of Environmental Services  
Water Division  
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April 2006



**New Hampshire Volunteer River Assessment Program  
2005 Lake Winnepesaukee Tributaries Water Quality Report**

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## **ACKNOWLEDGEMENTS**

The New Hampshire Department of Environmental Services (NHDES) - Volunteer River Assessment Program (VRAP) extends sincere thanks to the volunteers in the Lake Winnepesaukee Watershed Association during 2004. This report was created solely from the data collected by the volunteers listed below. Their time and dedication is an expression of their genuine concern for local water resources and has significantly contributed to our knowledge of river and stream water quality in New Hampshire.

### **2005 Lake Winnepesaukee Watershed Association Volunteers**

Kurt Dietzer  
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# **1. INTRODUCTION**

## **1.1. Purpose of Report**

Each year the VRAP prepares and distributes a water quality report for each volunteer group that is based solely on the water quality data collected by that volunteer group during a specific year. The reports summarize and interpret the data, particularly as they relate to New Hampshire surface water quality standards, and serve as a teaching tool and guidance document for future monitoring activities by the individual volunteer groups.

## **1.2. Report Format**

Each report includes the following:

### **❖ Volunteer River Assessment Program (VRAP) Overview**

This section includes a discussion of the history of VRAP, the technical support, training and guidance provided by NHDES, and how data is transmitted to the volunteers and used in surface water quality assessments.

### **❖ Monitoring Program Description**

This section provides a description of the volunteer group's monitoring program including monitoring objectives as well as a table and map showing sample station locations.

### **❖ Results and Discussion**

Water quality data collected during the year are summarized on a parameter-by-parameter basis using (1) a summary table that includes the number of samples collected, data ranges, the number of samples meeting New Hampshire water quality standards, and the number of samples adequate for water quality assessments at each station, (2) a discussion of the data, (3) a list of applicable recommendations, and (4) a river graph showing the range of measured values at each station. Sample results reported as less than the detection limit were assumed equal to one-half the detection limit on the river graphs. This approach simplifies the understanding of the parameter of interest, and specifically helps one to visualize how the river or watershed is functioning from upstream to downstream. In addition, this format allows the reader to better understand potential pollution areas and target those areas for additional sampling or environmental enhancements. Where applicable, the river graph also shows New Hampshire surface water quality standards or levels of concern for comparison purposes.

### ❖ **Appendix A – Data**

This appendix includes a spreadsheet showing the data results and additional information, such data results which do not meet New Hampshire surface water quality standards, and data that is unusable for assessment purposes due to quality control requirements.

### ❖ **Appendix B – Interpreting VRAP Water Quality Parameters**

This appendix includes a brief description of water quality parameters typically sampled by VRAP volunteers and their importance, as well as applicable state water quality criteria or levels of concern.

### ❖ **Appendix C – Glossary of River Ecology Terms**

This appendix contains a list of terms commonly used when discussing river ecology and water quality.

## **2. PROGRAM OVERVIEW**

### **2.1. Past, Present, and Future**

In 1998, the New Hampshire Department of Environmental Services (NHDES) initiated the New Hampshire Volunteer River Assessment Program (VRAP) as a means of expanding public education of water resources in New Hampshire. VRAP promotes awareness and education of the importance of maintaining water quality in rivers and streams. VRAP was created in the wake of the success of the existing New Hampshire Volunteer Lake Assessment Program (VLAP), which provides educational and stewardship opportunities pertaining to lakes and ponds to New Hampshire's residents.

Today, VRAP continues to serve the public by providing water quality monitoring equipment, technical support, and educational programs. In 2005, VRAP supported twenty-eight volunteer groups on numerous rivers and watersheds throughout the state. These volunteer groups conduct water quality monitoring on an ongoing basis. The work of the VRAP volunteers increases the amount of river water quality information available to local, state and federal governments, which allows for effective financial resource allocation and watershed planning.

### **2.2. Technical Support**

VRAP lends and maintains water quality monitoring kits for volunteer groups throughout the state. The kits contain electronic meters and supplies for “in-the-field” measurements of water temperature, dissolved oxygen, pH, specific conductance (conductivity), and turbidity. These are the core parameters typically measured by volunteers. However, other water quality parameters such as nutrients, metals, and *E. coli* can also be studied by volunteer groups, although VRAP does not always provide funds to cover laboratory analysis costs. Thus, VRAP encourages volunteer groups to pursue other fundraising activities such as association membership fees, special events, in-kind services (non-monetary contributions from individuals and organizations), and grant writing.

VRAP typically recommends sampling every other week during the summer, and volunteer groups are encouraged to organize a long-term sampling program in order to begin to determine trends in river conditions. Each year volunteers design and arrange a sampling schedule in cooperation with NHDES staff. Project designs are created through a review and discussion of existing water quality information, such as known and perceived problem areas or locations of exceptional water quality. The interests, priorities, and resources of the partnership determine monitoring locations, parameters, and frequency.

Water quality measurements repeated over time create a picture of the fluctuating conditions in rivers and streams and help to determine where improvements, restoration or preservation may benefit the river and the communities it supports. Water quality results are also used to determine if a river is meeting surface water quality standards. Volunteer monitoring results, meeting DES Quality Assurance and Quality Control (QA/QC) requirements, supplement the efforts of DES to



assess the condition of New Hampshire surface waters. The New Hampshire Surface Water Quality Regulations are available through the DES Public Information Center at [www.des.state.nh.us/wmb/Env-Ws1700.pdf](http://www.des.state.nh.us/wmb/Env-Ws1700.pdf) or (603) 271-1975.

### **2.3. Training and Guidance**

Each VRAP volunteer attends an annual training session to receive a demonstration of monitoring protocols and sampling techniques. Training sessions are an opportunity for volunteers to receive an updated version of monitoring techniques. During the training, volunteers have an opportunity for hand-on use of the VRAP equipment and may also receive instruction in the collection of samples for laboratory analysis. Training is accomplished in approximately two hours, after which volunteers are certified in the care, calibration, and use of the VRAP equipment. In some cases, veteran group coordinators can attend a “train the trainer” session. In these trainings the group coordinator receives an update in sampling protocols and techniques and will then train the individual volunteers of their respective group.

VRAP groups conduct sampling according to a prearranged monitoring schedule and VRAP protocols. NHDES staff from the VRAP program aim to visit each group annually during a scheduled sampling events to verify that volunteers successfully follow the VRAP protocols. If necessary, volunteers are re-trained during the visit, and the group’s monitoring coordinator is notified of the result of the verification visit. VRAP groups forward water quality results to NHDES for incorporation into an annual report and state water quality assessment activities.

### **2.4. Data Usage**

#### **2.4.1. Annual Water Quality Reports**

All data collected by volunteers are summarized in water quality reports that are prepared and distributed after the conclusion of the sampling period (typically fall or winter). Each volunteer group receives copies of the report. The volunteers can use the reports and data as a means of understanding the details of water quality, guiding future sampling efforts, or determining restoration activities.

#### **2.4.2. New Hampshire Surface Water Quality Assessments**

Along with data collected from other water quality programs, specifically the State Ambient River Monitoring Program, applicable volunteer data are used to support periodic DES surface water quality assessments. VRAP data are entered into NHDES’s Environmental Monitoring Database and are ultimately uploaded to the Environmental Protection Agency’s database, STORET. Assessment results and the methodology used to assess surface waters are published by DES every two years (i.e., Section 305(b) Water Quality Reports) as required by the federal Clean Water Act. The reader is encouraged to log on to the DES web page to review the

assessment methodology and list of impaired waters  
<http://www.des.state.nh.us/wmb/swqa/>.

## 2.5. Quality Assurance/Quality Control

In order for VRAP data to be used in the assessment of New Hampshire's surface waters, the data must meet quality control guidelines as outlined in the VRAP Quality Assurance Project Plan (QAPP). The VRAP QAPP was approved by NHDES and reviewed by EPA in the summer of 2003. The QAPP is reviewed annually and is officially updated and approved every five years. The VRAP Quality Assurance/Quality Control (QA/QC) measures include a six-step approach to ensuring the accuracy of the equipment and consistency in sampling efforts.

- ❖ **Calibration:** Prior to each measurement, the pH and dissolved oxygen meters are calibrated. Conductivity and turbidity meters are calibrated and/or checked against a known standard before the first measurement and after the last one.
- ❖ **Replicate Analysis:** A second measurement by each meter is taken from the original sample at one of the stations during the sampling day. The replicate analysis should not be conducted at the same station over and over again, but should be conducted at different stations throughout the monitoring season.
- ❖ **6.0 pH Standard:** A reading of the pH 6.0 buffer is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the 6.0 pH standard check should be conducted at different stations.
- ❖ **Zero Oxygen Standard:** A reading of a zero oxygen solution is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the zero oxygen standard check should be conducted at different stations.
- ❖ **DI Turbidity Blank:** A reading of the DI blank is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the blank check should be conducted at different stations.
- ❖ **Post-Calibration:** At the conclusion of each sampling day, all meters are calibrated.

### 2.5.1. Measurement Performance Criteria

Precision is calculated for field and laboratory measurements through measurement replicates (instrumental variability) and is calculated for each sampling day. The use of VRAP data for assessment purposes is contingent on compliance with a parameter-specific relative percent difference (RPD) as derived from equation 1, below. Any data exceeding the limits of the individual measures are disqualified from surface water quality assessments. All data that exceeds the limits defined by the VRAP QAPP are acknowledged in the data tables with an explanation of why the data was unusable. Table 1 shows typical parameters studied under VRAP and the associated quality control procedures.

(Equation 1)

$$RPD = \frac{|x_1 - x_2|}{\frac{x_1 + x_2}{2}} \times 100 \%$$

where  $x_1$  is the original sample and  $x_2$  is the replicate sample

**Table 1. Field Analytical Quality Controls**

Water Quality Parameter	QC Check	QC Acceptance Limit	Corrective Action	Person Responsible for Corrective Action	Data Quality Indicator
Temperature	Measurement replicate	± 0.2 °C	Repeat measurement	Volunteer Monitors	Precision
Dissolved Oxygen	Measurement replicate	± 2% of saturation, or ± 0.2 mg/L	Recalibrate instrument, repeat measurement	Volunteer Monitors	Precision
	Known buffer (zero O <sub>2</sub> solution)	<0.5 mg/L	Recalibrate instrument, repeat measurement	Volunteer Monitors	Relative accuracy
pH	Measurement replicate	± 0.1 std units	Recalibrate instrument, repeat measurement	Volunteer Monitors	Precision
	Known buffer (pH = 6.0)	± 0.1 standard units	Recalibrate instrument repeat measurement	Volunteer Monitors	Accuracy
Specific Conductance	Measurement replicate	± 30 µS/cm	Recalibrate instrument, repeat measurement	Volunteer Monitors	Precision
	Method blank (Zero air reading)	± 5.0 µS/cm	Recalibrate instrument, repeat measurement	Volunteer Monitors	Accuracy
Turbidity	Measurement replicate	± 0.1 NTU	Recalibrate instrument, repeat measurement	Volunteer Monitors	Precision
	Method blank (DI Water)	± 0.1 NTU	Recalibrate instrument, repeat measurement	Volunteer Monitors	Accuracy

### 3. METHODS

During the summer of 2004, volunteers from the Lake Winnepesaukee Watershed Association began water quality monitoring on the tributaries feeding into Lake Winnepesaukee. The goal of this effort was to provide water quality data from the Lake Winnepesaukee tributaries relative to surface water quality standards and to allow for the assessment of the river for support of aquatic life and primary contact recreation (swimming). The establishment of a long-term monitoring program will allow for an understanding of the river's dynamics, or variations on a station-by-station and year-to-year basis. The data can also serve as a baseline from which to determine any water pollution problems in the river and/or watershed. The Volunteer River Assessment Program has provided field training, equipment, and technical assistance.

During 2005, trained volunteers from the Lake Winnepesaukee Watershed Association monitored water quality at 16 stations along the tributaries of Lake Winnepesaukee (Figure 1, Table 2). Stations IDs are designated using a three letter code to identify the waterbody name plus a number indicating the relative position of the station. The higher the station number the more upstream the station is in the watershed.

Water quality monitoring was conducted monthly from April to September. In-situ measurements of water temperature, air temperature, dissolved oxygen, pH, turbidity and specific conductance were taken using handheld meters provided by NHDES. Samples for chloride were taken using bottles supplied by the NHDES laboratory and were stored on ice during transport from the field to the NHDES lab. Samples for total phosphorous, nitrate and *E.coli* were processed at the University of New Hampshire New Hampshire. Table 3 summarizes the parameters measured, laboratory standard methods, and equipment used.

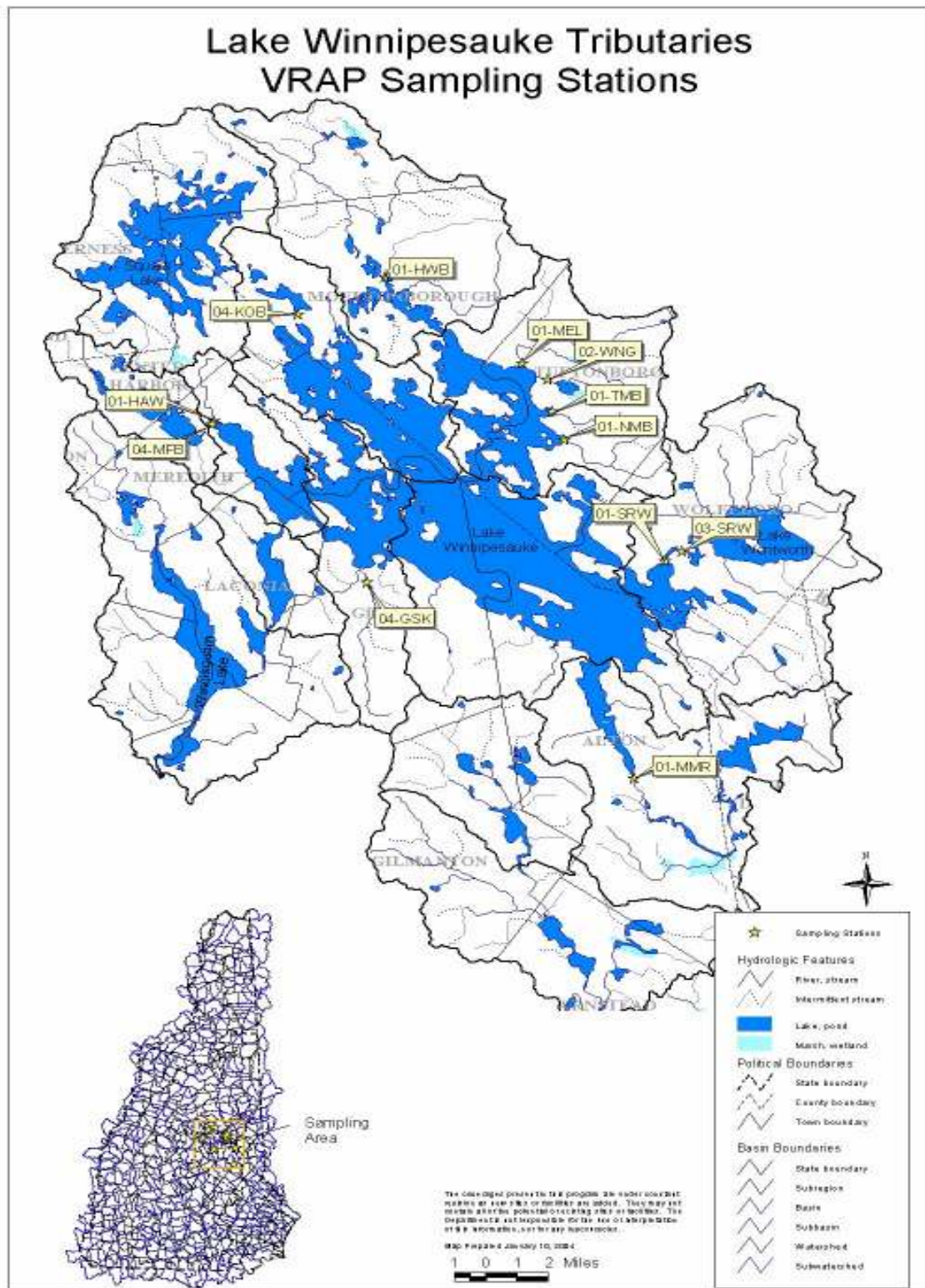
**Table 2. Sampling Stations for the Lake Winnepesaukee Tributaries, NHDES VRAP, 2005**

NHDES Station ID	LWA Station ID	Waterbody Name	Location	Town/City	Elevation*
07-HAW	-----	Hawkins Brook	Route 3 Bridge 1st Crossing	Meredith	500
06B-HAW	-----	Hawkins Brook	Jenness Hill Road Bridge	Meredith	500
06A-HAW	-----	Hawkins Brook	Upstream of Jenness Hill Road Bridge	Meredith	500
05-HAW	-----	Hawkins Brook	Route 3 Bridge 2nd Crossing	Meredith	500
01-HAW	Me1	Hawkins Brook	Route 25 Bridge	Meredith	500
01-MMR	Al1	Merrymeeting River	Route 11 Bridge	Alton	500
04-GSK	Gi1	Gunstock River	Old Lake Shore Road Bridge	Gilford	500

<b>02-MFB</b>	<b>Me2</b>	Mills Falls Brook	Route 3/25 Bridge	Meredith	500
<b>04-KOB</b>	<b>Mo1</b>	Lake Kanasatka Outlet	Route 25 Bridge	Moultonborough	500
<b>01-HWB</b>	<b>Mo2</b>	Halfway Brook	Lees Mill Road	Moultonborough	500
<b>01-MEL</b>	<b>Tu3</b>	Melvin River	Route 109 Bridge	Tuftonboro	500
<b>02-WNG</b>	<b>Tu4</b>	Wingate River	Route 109 Bridge	Tuftonboro	500
<b>01-TMB</b>	<b>Tu2</b>	Twentymile Brook	Route 109 Bridge	Tuftonboro	500
<b>01-NMB</b>	<b>Tu1</b>	Nineteenmile Brook	Route 109 Bridge	Tuftonboro	500
<b>03-SRW</b>	<b>Wo1</b>	Smith River	Crescent Lake Outlet	Wolfeboro	500
<b>01-SRW</b>	<b>Wo2</b>	Smith River	Back Bay Outlet	Wolfeboro	500

\*Elevations have been rounded off to 100-foot increments for calibration of dissolved oxygen meter

**Figure 1. Lake Winnepesaukee Tributaries Watershed and Monitoring Stations 2005**



**Table 3. Sampling and Analysis Methods**

Parameter	Sample Type	Standard Method	Equipment Used	Laboratory
Temperature	In-Situ	SM 2550	YSI 95	-----
Dissolved Oxygen	In-Situ	SM 4500 O G	YSI 95	-----
pH	In-Situ	SM 4500 H+	Orion 210A+	-----
Turbidity	In-Situ	EPA 180.1	Lamotte 2020	-----
Specific Conductance	In-Situ	SM 2510	YSI 30	-----
Chloride	Bottle	EPA 325.2	-----	NHDES
<i>E. coli</i>	Bottle (Sterile)	SM 19 9213 D.3	-----	UNH
Total Phosphorus	Bottle (w/Preservative)	SM 4500 PE	-----	UNH
Nitrate	Bottle	EPA 353	-----	UNH

## 4.0 RESULTS AND DISCUSSION

### 4.1. Dissolved Oxygen

Between one and seven measurements were taken in the field for dissolved oxygen concentration at 15 stations in the Lake Winnepesaukee watershed. (Table 4). Of the 76 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency.

The Class B New Hampshire surface water quality standard for dissolved oxygen includes a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be assessed as meeting dissolved oxygen standards. Table 4 reports only dissolved oxygen concentration as more detailed analysis is required to determine if instantaneous dissolved oxygen saturation measurements are above or below water quality standards.

**Table 4. Dissolved Oxygen Concentration Data Summary – Lake Winnepesaukee Tributaries, 2005**

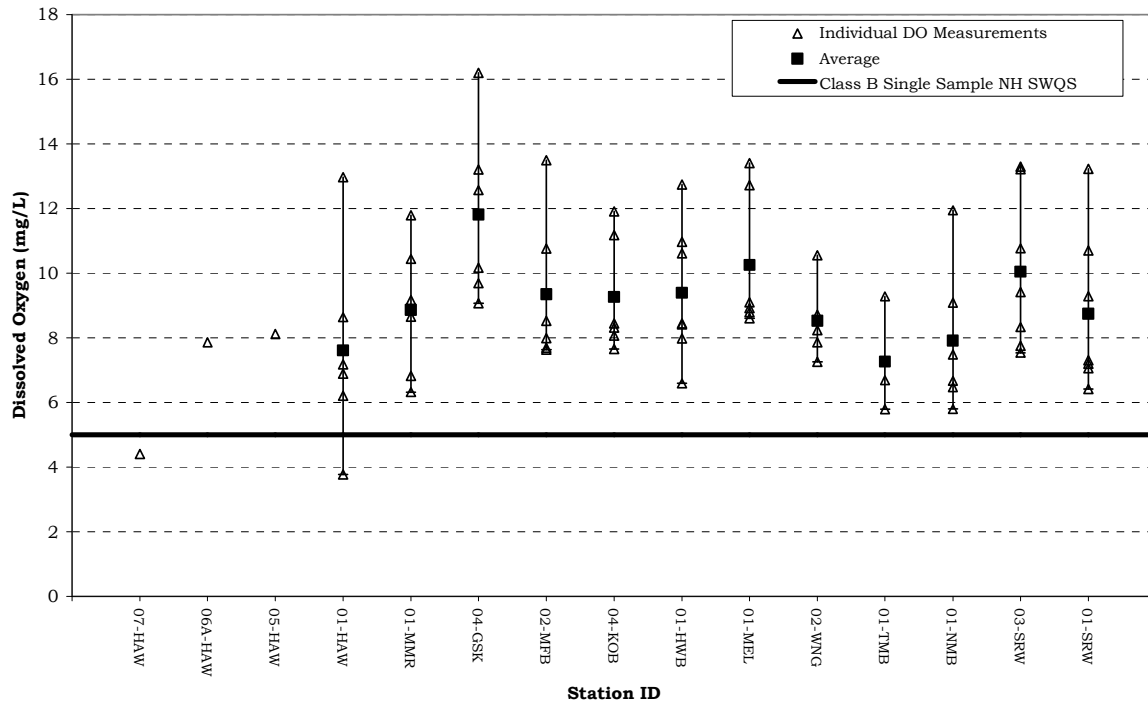
Station ID	Samples Collected	Data Range (mg/l)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2006 NH Surface Water Quality Assessment
07-HAW	1	4.41	1	1
06A-HAW	1	7.86	0	1
05-HAW	1	8.12	0	1
01-HAW	6	3.77 - 12.97	1	6
01-MMR	6	6.32 - 11.79	0	6
04-GSK	6	9.07 - 16.20	0	6
02-MFB	6	7.64 - 13.50	0	6
04-KOB	6	7.65 - 11.91	0	6
01-HWB	7	6.59 - 12.75	0	7
01-MEL	6	8.61 - 13.41	0	6
02-WNG	5	7.26 - 10.55	0	5
01-TMB	5	5.79 - 9.28	0	5
01-NMB	6	5.80 - 11.95	0	6
03-SRW	7	7.54 - 13.30	0	7
01-SRW	7	6.41 - 13.23	0	7
<b>Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment</b>				<b>76</b>

Dissolved oxygen concentration levels were above state standards at all stations on most occasions (Figure 2). Stations 07-HAW and 01-HAW had single dissolved oxygen concentration levels below the state standard. The average concentration of dissolved oxygen was consistently above the Class B standard at all stations where at least three measurements were taken ranging from 7.3 mg/L to 11.8 mg/L. Levels of dissolved



oxygen sustained above the standards are considered adequate for the support of aquatic life and other desirable water quality conditions.

**Figure 2. Dissolved Oxygen Statistics - Lake Winnepesaukee Tributaries  
April 5 - September 16, 2005, NHDES VRAP**



## Recommendations

- ❖ Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.
- ❖ If possible, take measurements between 5:00 a.m. and 10:00 a.m., which is when dissolved oxygen is usually the lowest, and between 2:00 p.m. and 7:00 p.m. when dissolved oxygen is usually the highest. In general, dissolved oxygen levels are lowest in the early morning when there is low photosynthetic activity and a peak in respiration from organisms throughout the water column. This is the time of least oxygen production and greatest carbon dioxide emission. Peak dissolved oxygen levels occur when photosynthetic activity is at its peak. The greater the amount of photosynthetic activity the greater the production of oxygen as a byproduct of photosynthesis.
- ❖ Next year incorporate the use of in-situ dataloggers to automatically record dissolved oxygen saturation levels during a period of several days. This will allow for the calculation of the daily average for dissolved oxygen per cent saturation. Dataloggers can be put in the water for a period of several days and collect data at specific time intervals (e.g. every 15 minutes). The use of these instruments is dependent upon availability, and requires coordination with NHDES.

## 4.2 pH

Between one and seven measurements were taken in the field for pH at 14 stations in the Lake Winnepesaukee watershed [Table 5]. Of the 74 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency.

The Class B New Hampshire surface water quality standard is 6.5 - 8.0, unless naturally occurring.

**Table 5. pH Data Summary – Lake Winnepesaukee Tributaries, 2005**

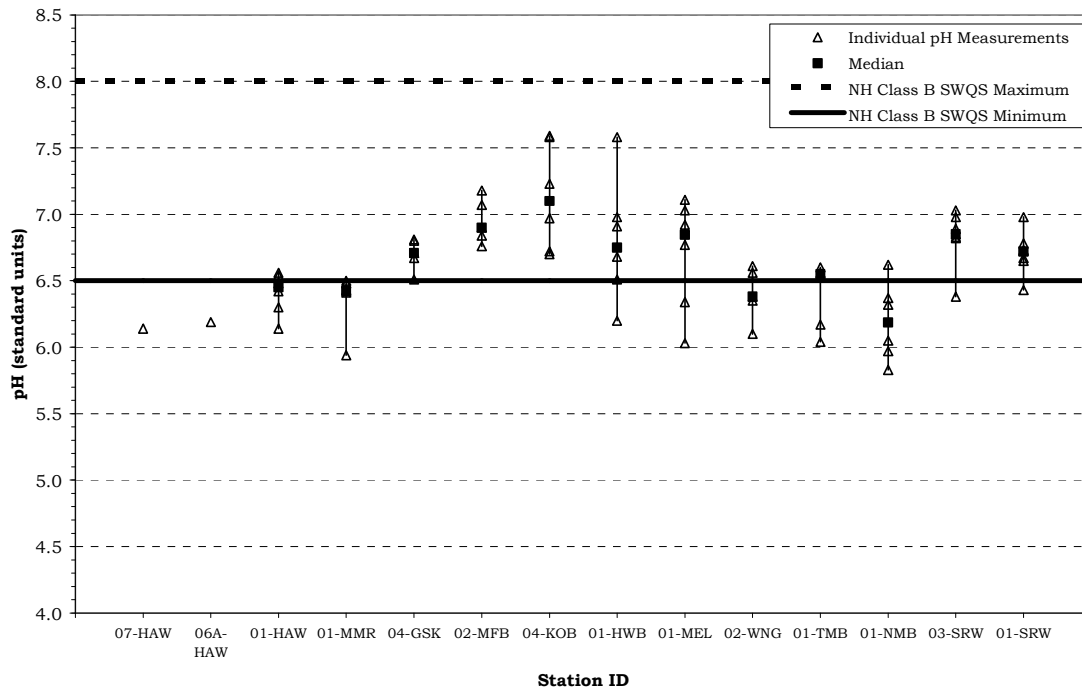
Station ID	Samples Collected	Data Range (standard units)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2006 NH Surface Water Quality Assessment
07-HAW	1	6.14	1	1
06A-HAW	1	6.19	1	1
01-HAW	6	6.14 - 6.56	0	6
01-MMR	6	5.94 - 6.50	5	6
04-GSK	6	6.51 - 6.81	0	6
02-MFB	5	6.76 - 7.18	0	5
04-KOB	6	6.70 - 7.59	0	6
01-HWB	7	6.20 - 7.58	1	7
01-MEL	6	6.03 - 7.11	2	6
02-WNG	5	6.10 - 6.61	3	5
01-TMB	5	6.04 - 6.60	2	5
01-NMB	6	5.83 - 6.62	5	6
03-SRW	7	6.38 - 7.03	1	7
01-SRW	7	6.43 - 6.98	1	7
<b>Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment</b>				<b>74</b>

A majority of the stations monitored had pH measurements that were outside of the range of the New Hampshire surface water quality standard (Figure 3). This is likely the result of natural conditions such as the soils, geology, or the presence of wetlands in the area. It should be noted that rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels.

The pH levels were generally lower in the smaller tributaries than in those that are draining larger bodies of water such as Lake Kanasatka and Lake Wentworth. This is likely due to the smaller tributaries having a lower acid neutralizing capacity or

alkalinity. The pH of these smaller tributaries can be quickly lowered due to rainfall, snowfall, or overland runoff.

**Figure 3. pH Statistics - Lake Winnepesaukee Tributaries  
April 5 - September 16, 2005, NHDES VRAP**



## Recommendations

- ❖ Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.
- ❖ Consider sampling for pH in some of the tributaries and wetland areas that are influencing the pH of stations with measurements below state standards. Site conditions are considered along with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands or other natural conditions, then the low pH measurements are not considered a violation of water quality standards. It is important to note that the New Hampshire water quality standard for pH is fairly conservative, thus pH levels slightly below the standard are not necessarily harmful to aquatic life. In this case, additional information about factors influencing pH levels is needed.

### 4.3 Turbidity

Between one and seven measurements were taken in the field for turbidity at 14 stations in the Lake Winnepesaukee watershed [Table 6]. Of the 72 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency.

The Class B New Hampshire surface water quality standard for turbidity is less than 10 NTU above background.

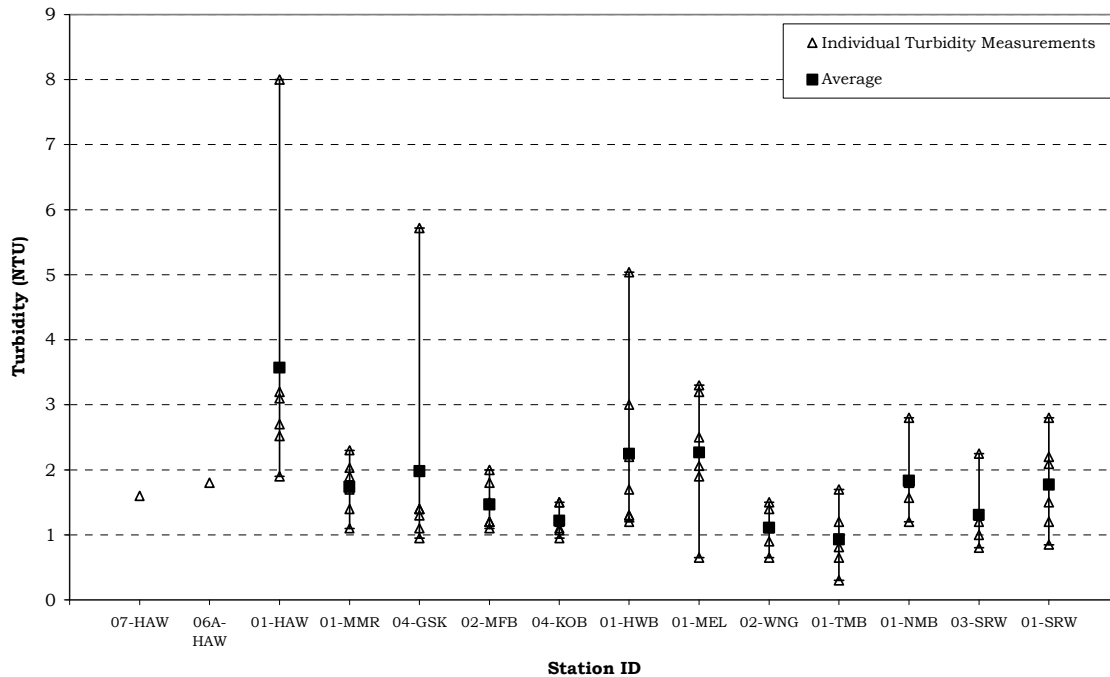
**Table 6. Turbidity Data Summary – Lake Winnepesaukee Tributaries, 2005**

Station ID	Samples Collected	Data Range (NTU)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2006 NH Surface Water Quality Assessment
07-HAW	1	1.6	0	1
06A-HAW	1	1.8	0	1
01-HAW	6	1.9 - 8.0	0	6
01-MMR	6	1.1 - 2.3	0	6
04-GSK	6	1.0 - 5.7	0	6
02-MFB	6	1.1 - 2.0	0	6
04-KOB	6	1.0 - 1.5	0	6
01-HWB	7	1.2 - 5.0	0	7
01-MEL	6	0.7 - 3.3	0	6
02-WNG	5	0.7 - 1.5	0	5
01-TMB	5	0.3 - 1.7	0	5
01-NMB	5	1.2 - 2.8	0	5
03-SRW	6	0.8 - 2.3	0	6
01-SRW	6	0.9 - 2.8	0	6
<b>Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment</b>				<b>72</b>

Turbidity levels were low on all occasions and at all stations with the average ranging from 0.9 NTU to 3.6 NTU (Figure 4). Although clean waters are associated with low turbidity there is a high degree of natural variability involved. Precipitation often contributes to increased turbidity by flushing sediment, organic matter and other materials from the surrounding landscape into surface waters. However, human activities such as removal of vegetation near surface waters and disruption of nearby soils can lead to dramatic increases in turbidity levels. In

general it is typical to see a rise in turbidity in more developed areas due to increased runoff.

**Figure 4. Turbidity Statistics - Lake Winnepesaukee Tributaries  
April 5 - September 16, 2005, NHDES VRAP**



## Recommendations

- ❖ Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.
- ❖ Collect samples during wet weather. This will help us to understand how the river responds to runoff and sedimentation.
- ❖ If a higher than normal turbidity measurement occurs, volunteers can investigate further by moving upstream and taking additional measurements. This will facilitate isolating the location of the cause of the elevated turbidity levels. In addition, take good field notes and photographs. If human activity is suspected or verified as the source of elevated turbidity levels volunteers should contact NHDES.

## 4.4 Specific Conductance

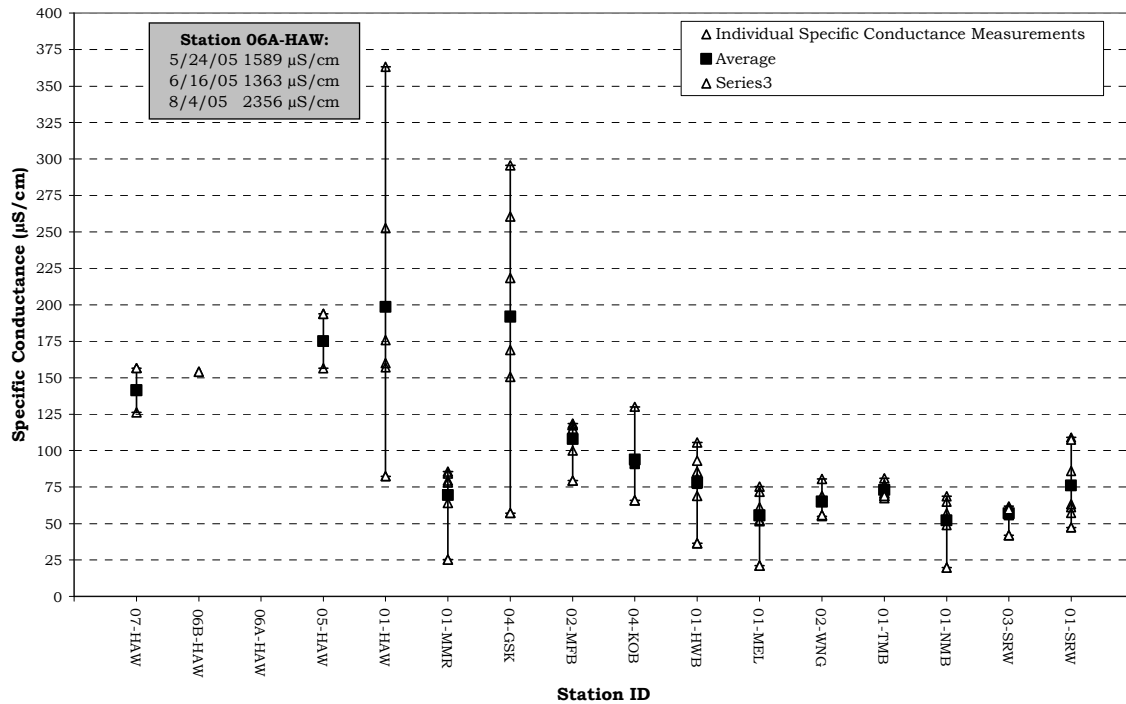
Between two and seven measurements were taken in the field for specific conductance at 15 stations in the Lake Winnepesaukee watershed [Table 7]. Of the 80 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency. New Hampshire surface water quality standards do not contain numeric limits for specific conductance.

**Table 7. Specific Conductance Data Summary – Lake Winnepesaukee Tributaries, 2005**

Station ID	Samples Collected	Data Range (µS/cm)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2006 NH Surface Water Quality Assessment
07-HAW	2	126.2 - 156.6	Not Applicable	2
06A-HAW	3	154.1 - 2356	N/A	3
05-HAW	2	156.4 - 193.7	N/A	2
01-HAW	6	82.4 - 363.2	N/A	6
01-MMR	6	25.3 - 85.6	N/A	6
04-GSK	6	57.2 - 295.7	N/A	6
02-MFB	6	79.4 - 118.6	N/A	6
04-KOB	6	65.9 - 130.0	N/A	6
01-HWB	7	36.4 - 105.5	N/A	7
01-MEL	6	21.1 - 75.3	N/A	6
02-WNG	5	55.0 - 80.5	N/A	5
01-TMB	5	67.4 - 81.0	N/A	5
01-NMB	6	19.7 - 68.6	N/A	6
03-SRW	7	41.9 - 61.9	N/A	7
01-SRW	7	47.3 - 109.0	N/A	7
<b>Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment</b>				<b>80</b>

Specific conductance levels in the Lake Winnepesaukee watershed were variable with the average ranging from 52 µS/cm to 199 µS/cm (Figure 5). Station 06A-HAW had very high specific conductance levels with an average of 1769 µS/cm. However this station is largely stormwater runoff and not formally part of Hawkins Brook. Higher specific conductance levels can be indicative of pollution from sources such as urban/agricultural runoff, road salt, failed septic systems, or groundwater pollution. Thus, the variable specific conductance levels in the Lake Winnepesaukee watershed indicate variable pollutant levels.

**Figure 5. Specific Conductance Statistics - Lake Winnepesaukee Tributaries  
April 5 - September 16, 2005, NHDES VRAP**



## Recommendations

- ❖ Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.
- ❖ Continue collecting chloride samples at the same time specific conductance is measured. During the late winter/early spring snowmelt, higher conductivity levels are often seen due to elevated concentrations of chloride in the runoff. Conductivity levels are very closely correlated to chloride levels. Simultaneously measuring chloride and conductivity will allow for a better understanding of their relationship.

## 4.5 Chloride

Either one or two samples for chloride were collected at four stations in Hawkins Brook watershed (Table 8). Of the 7 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency.

The Class B New Hampshire surface water quality standard for chloride is as follows:

Freshwater chronic criterion	230 mg/l
Freshwater acute criterion	860 mg/l

**Table 8. Chloride Data Summary – Lake Hawkins Brook Watershed, 2005**

Station ID	Samples Collected	Data Range (mg/L)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2006 NH Surface Water Quality Assessment
07-HAW	2	24 - 36	0	2
06B-HAW	1	31	0	1
06A-HAW	2	430 - 480	2	2
05-HAW	2	32 - 45	0	2
<b>Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment</b>				<b>7</b>

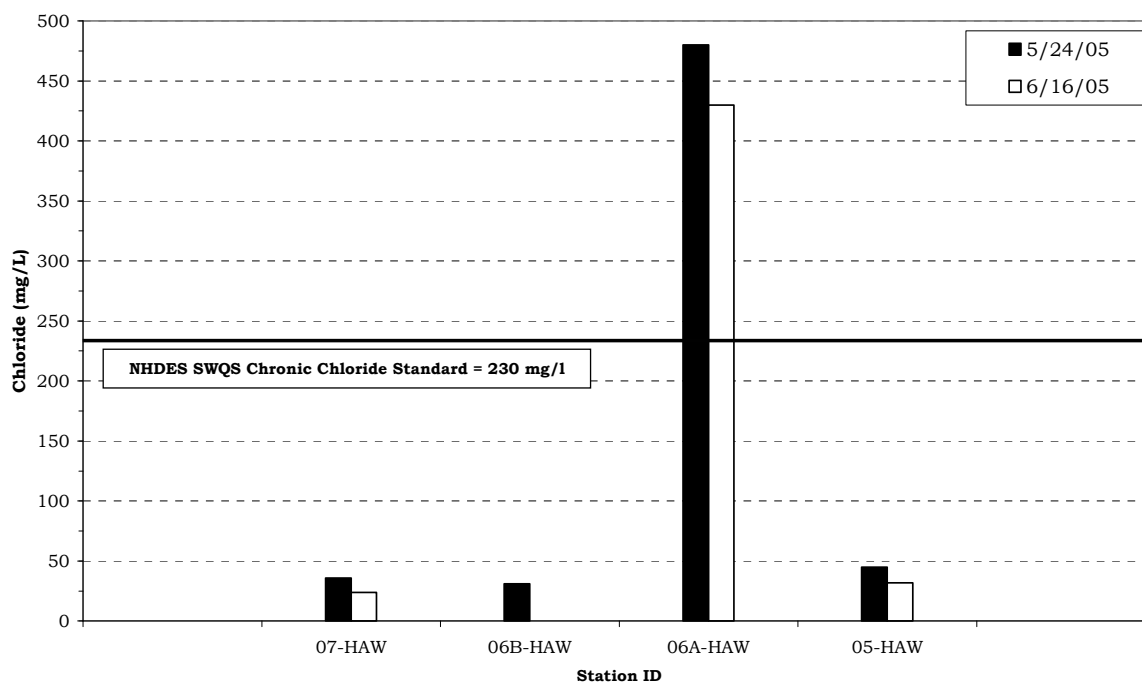
Chloride concentrations were below the chronic Class B surface water quality standard at stations 07-HAW, 06B-HAW, and 05-HAW. Chloride concentrations were above the chronic Class B surface water quality standard at station 06B-HAW.

Although chloride can originate from natural sources, most of the chloride that enters the environment is associated with the storage and application of road salt. Road salt readily dissolves and enters aquatic environments in ionic forms. As such, chloride-containing compounds commonly enter surface water, soil, and groundwater during late-spring snowmelt (since the ground is frozen during much of the late winter and early spring). Chloride ions are conservative, which means they are not degraded in the environment and tend to remain in solution, once dissolved. Chloride ions that enter ground water can ultimately be expected to reach surface water and, therefore, influence aquatic environments and humans.

Additional human sources of chloride can come from fertilizers, septic systems, and underground water softening systems.



**Figure 6. Chloride Statistics - Hawkins Brook Watershed  
May 24 and June 16, 2005, NHDES VRAP**



## Recommendations

- ❖ Target additional sampling to those periods when chloride levels are likely to be highest (snowmelt).
- ❖ Continue to take specific conductance measurements simultaneously with chloride samples.

## 4.6 *Escherichia coli*/Bacteria

One sample was collected for *Escherichia coli* (*E. coli*) at 10 stations in the Lake Winnepesaukee watershed (Table 9). Of the 10 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency.

Class B NH surface water quality standards for *E.coli* are as follows:

- <406 cts/100 ml, based on any single sample, or
- <126 cts/100 ml, based on a geometric mean calculated from three samples collected within a 60-day period.

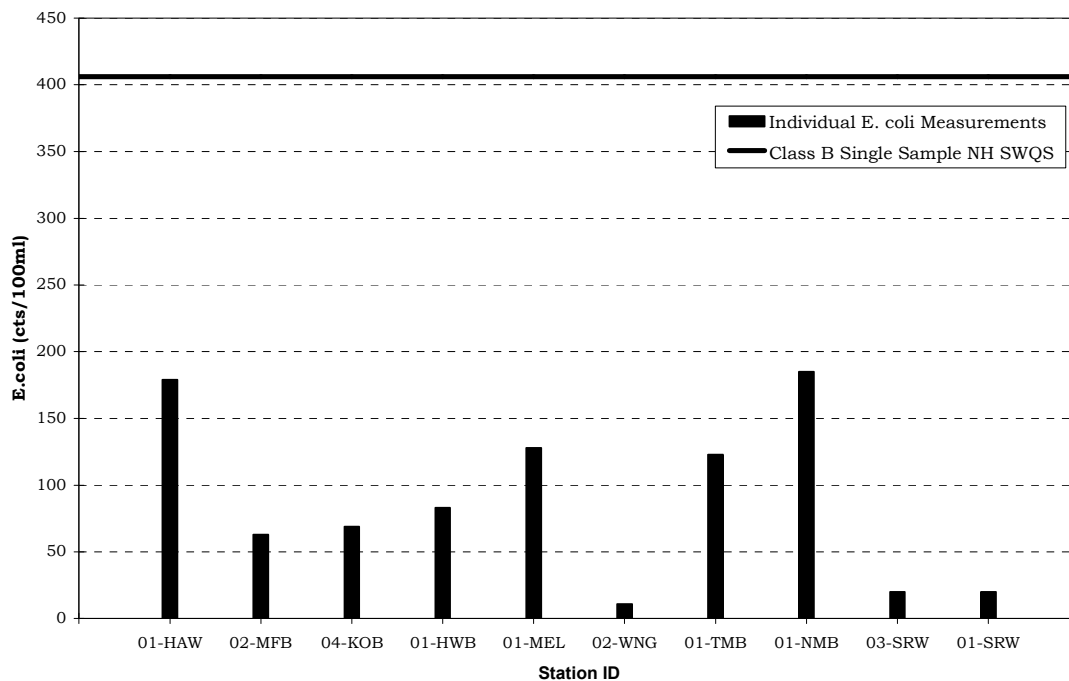
**Table 9. *E.coli* Data Summary – Lake Winnepesaukee Tributaries, 2005**

Station ID	Samples Collected	Data Range (cts/100ml)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2006 NH Surface Water Quality Assessment
01-HAW	1	179	0	1
02-MFB	1	63	0	1
04-KOB	1	69	0	1
01-HWB	1	83	0	1
01-MEL	1	128	0	1
02-WNG	1	11	0	1
01-TMB	1	123	0	1
01-NMB	1	185	0	1
03-SRW	1	20	0	1
01-SRW	1	20	0	1
<b>Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment</b>				<b>10</b>

None of the samples exceeded the single sample standard of 406 cts/100 ml. In order to fully determine whether a waterbody is meeting surface water standards for *E.coli* a geometric mean must be calculated. A geometric mean is calculated using three samples collected within a 60-day period.

Several factors can contribute to elevated *E. coli* levels, including, but not limited to rain storms, low river flows, the presence of wildlife (e.g., birds), and the presence of septic systems along the river.

**Figure 7. *Escherichia coli* Statistics - Lake Winnepesaukee Tributaries  
June 16, 2005, NHDES VRAP**



## Recommendations

- ❖ Collect three samples within any 60-day period during the summer to allow for determination of geometric means.
- ❖ Continue to document river conditions and station characteristics (including the presence of wildlife in the area during sampling).
- ❖ At stations with particularly high bacteria levels volunteers can investigate further by moving upstream and taking additional measurements. This will facilitate isolating the location of the cause of the elevated bacteria levels. Those sampling should also look for any potential sources of bacteria such as emission pipes and failed septic systems.

## 4.7 Total Phosphorus

Between five and seven samples were collected for total phosphorous at 12 stations in the Lake Winnepesaukee watershed (Table 10). Of the 70 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency.

There is no numeric standard for total phosphorus for Class B waters. The narrative standard states that "unless naturally occurring, shall contain no phosphorus in such concentrations that would impair any existing or designated uses." The NHDES "level of concern" for total phosphorous is 0.05 mg/L.

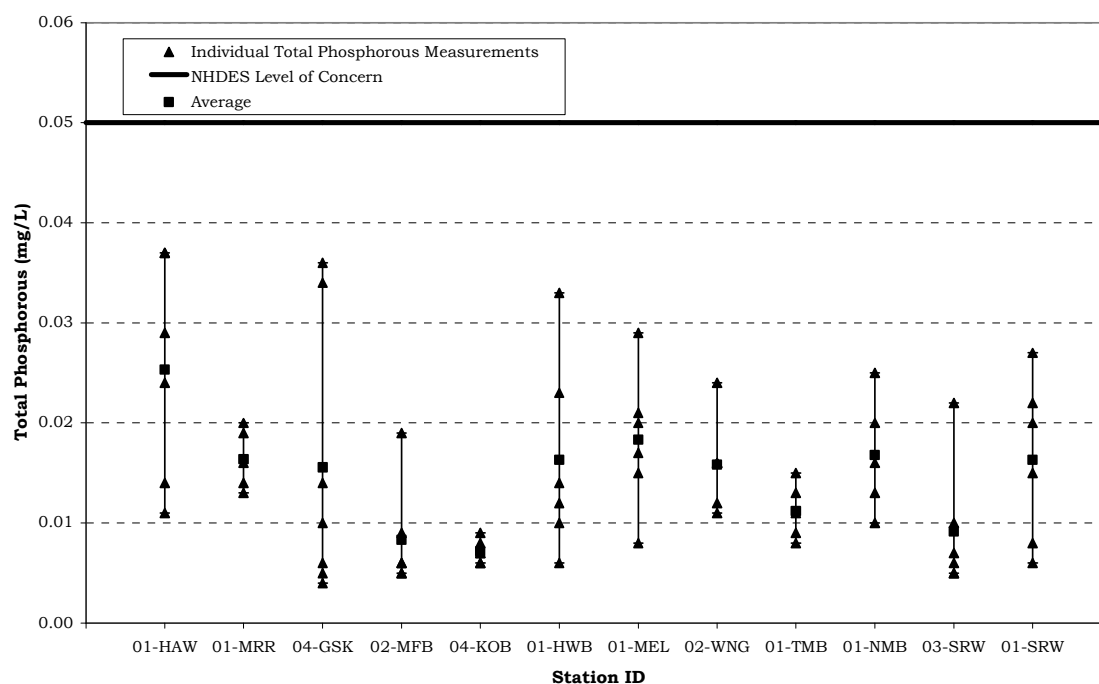
**Table 10. Total Phosphorus Data Summary – Lake Winnepesaukee Tributaries, 2005**

Station ID	Samples Collected	Data Range (mg/L)	Acceptable Samples Exceeding NHDES Level of Concern	Number of Usable Samples for 2006 NH Surface Water Quality Assessment
01-HAW	6	0.011 - 0.14	0	6
01-MRR	5	0.013 - 0.02	0	5
04-GSK	7	0.004 - 0.036	0	7
02-MFB	6	0.005 - 0.019	0	6
04-KOB	6	0.006 - 0.009	0	6
01-HWB	6	0.006 - 0.033	0	6
01-MEL	6	0.008 - 0.029	0	6
02-WNG	6	0.011 - 0.024	0	6
01-TMB	5	0.008 - 0.015	0	5
01-NMB	5	0.01 - 0.025	0	5
03-SRW	6	0.005 - 0.022	0	6
01-SRW	6	0.006 - 0.22	0	6
<b>Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment</b>				<b>70</b>

All stations on all occasions were below the NHDES "level of concern" for total phosphorous. Under undisturbed natural conditions phosphorous is at very low levels in aquatic ecosystems. Of the three nutrients critical for aquatic plant growth; potassium, nitrogen, and phosphorous, it is usually phosphorous that is the limiting factor to plant growth. When the supply of phosphorous is increased due to human activity, algae respond with significant growth.

A major source of excessive phosphorous concentrations in aquatic ecosystems can be wastewater treatment facilities, as sewage typically contains relatively high levels of phosphorus detergents. However, fertilizers used on lawns and agricultural areas can also contribute significant amounts of phosphorus.

**Figure 8. Total Phosphorous Statistics - Lake Winnepesaukee Tributaries  
April 5 - September 16, 2005, NHDES VRAP**



## Recommendations

- ❖ Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.

## 4.8 Nitrate

Between four and six samples were collected for nitrate at 12 stations in the Lake Winnepesaukee watershed (Table 11). Of the 60 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency.

There is no numeric standard for nitrogen for Class B waters. The narrative standard states that "unless naturally occurring, shall contain no nitrogen in such concentrations that would impair any existing or designated uses."

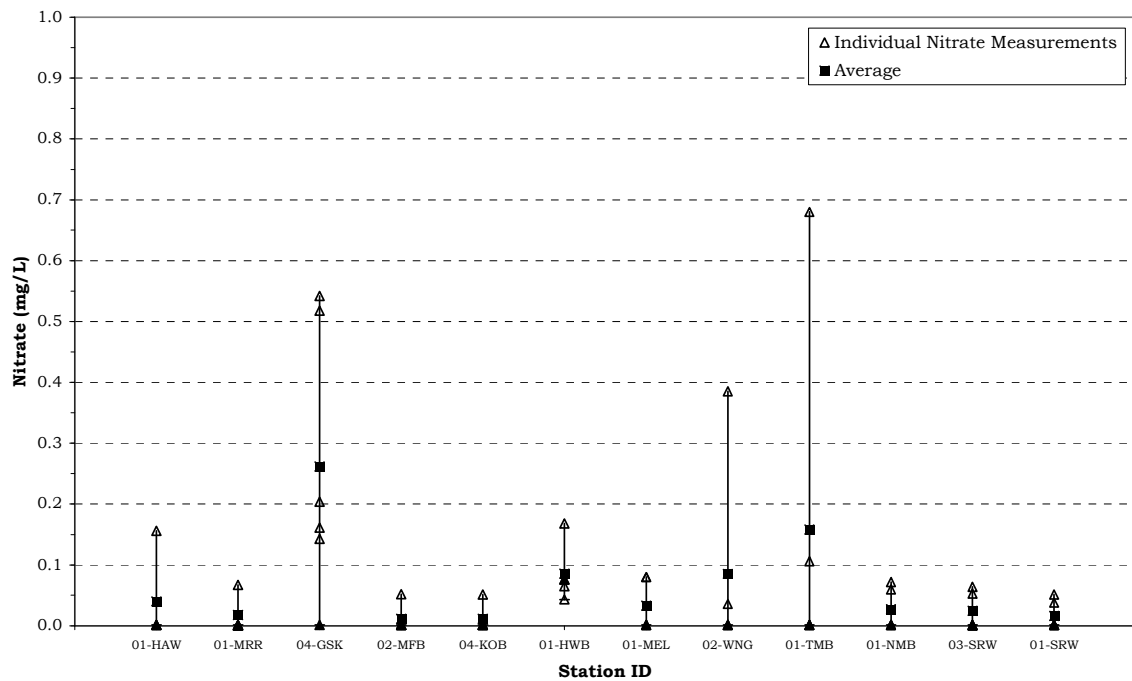
**Table 11. Nitrate Data Summary – Lake Winnepesaukee Tributaries, 2005**

Station ID	Samples Collected	Data Range (mg/L)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2006 NH Surface Water Quality Assessment
01-HAW	4	BDL* - 0.156	Not Applicable	4
01-MRR	4	BDL - 0.067	N/A	4
04-GSK	6	0.143 - 0.542	N/A	6
02-MFB	5	BDL - 0.052	N/A	5
04-KOB	5	BDL - 0.051	N/A	5
01-HWB	5	0.043 - 0.168	N/A	5
01-MEL	5	BDL - 0.08	N/A	5
02-WNG	5	BDL - 0.385	N/A	5
01-TMB	5	BDL - 0.68	N/A	5
01-NMB	5	BDL - 0.072	N/A	5
03-SRW	5	BDL - 0.064	N/A	5
01-SRW	6	BDL - 0.051	N/A	6
<b>Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment</b>				<b>60</b>

\*The detection limit for the method used was 0.03 mg/L.

A majority of nitrate measurements were below the 0.03 mg/L detection limit of the standard method used. Nitrogen is naturally occurring in soil in organic forms from decomposing plant and animal matter. Bacteria in the soil then convert nitrogen to nitrate, a nitrogen-oxygen chemical unit. Primary sources which can cause increased nitrate levels are human sewage, livestock manure, and agricultural fertilizers. Higher nitrate levels at some stations can likely be attributed to land and water management practices.

**Figure 9. Nitrate Statistics - Lake Winnepesaukee Tributaries**  
**April 5 - September 16, 2005, NHDES VRAP**



## Recommendations

- ❖ Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.

## **APPENDIX A**

### **2005 Lake Winnepesaukee Tributaries Water Quality Data**



## **APPENDIX B**

### **Interpreting VRAP Water Quality Parameters**

## **APPENDIX C**

### **Glossary of River Ecology Terms**